Air Quality

AIR POLLUTION

Air pollution comes from motor vehicles, industry, small businesses and everyday activities like using cleaning solutions, paints and thinners and lawn and garden equipment. Air pollution can have numerous health effects. Children, the elderly and people with lung diseases are especially susceptible to health complications from air pollution. Pollutants in the air we breathe can cause a scratchy throat, coughing, difficulty breathing, watery eyes, inflamed lung tissue, aggravated asthma, lung disease, cancer, reduced immune defenses and other problems.

Indiana's air has become significantly cleaner in the last 10 years. Stricter regulations for motor vehicles and industry, and other emission reduction programs have reduced smog and dust levels and improved visibility. Indiana's air meets health standards set by the U.S. Environmental Protection Agency (U.S. EPA) for sulfur dioxide, nitrogen dioxide, carbon monoxide, lead and coarse particles of dust and soot (PM_{10}) at air quality monitors located across the state.

There are still areas and pollutants of concern to address. Some parts of Indiana exceed recently adopted standards for ozone, or smog, on some hot, sunny days. Air monitoring also shows that some areas of the state have higher levels of fine particles of dust ($PM_{2.5}$) in the air than is deemed safe by U.S. EPA standards. Levels of toxic chemicals, for which there are no federal health standards, are also of concern in Indiana.

OZONE

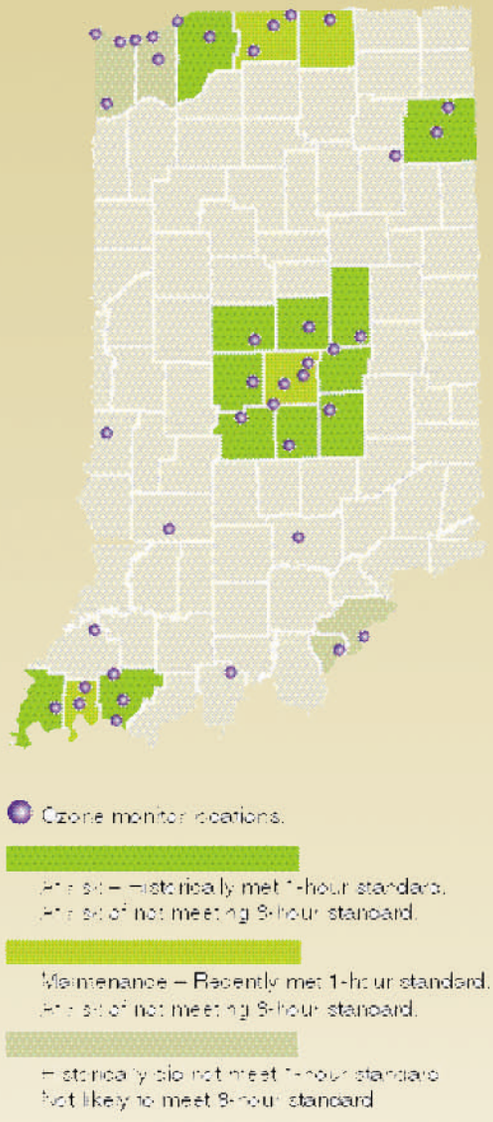
Ozone in the upper atmosphere is the "good" ozone that protects us from the sun's radiation. Ground-level ozone, which is formed when volatile organic compounds (VOCs), nitrogen oxides (NOx) and sunlight mix, is the "bad" ozone that irritates lungs and causes significant health problems for many people. Ozone is an air quality problem in the summer months when temperatures are high and the daylight hours are long. Ozone can lead to reduced lung function, increased respiratory inflammation, coughing, chest pain and nausea. Children are especially at risk from ground-level ozone, because they breathe more air per pound than adults and spend more time outdoors.

Historically, the nation's ozone standard was 125 parts per billion (ppb), measured over one hour. Indiana monitors ozone in areas where ozone levels are expected to be high, due to dense population and manufacturing activities. When a monitor in an area exceeded the standard more than three times in three years that area violated the standard. In 2000, only one monitor recorded ozone levels over the one-hour health standard of 125 ppb, with a reading of 128 ppb in St. Joseph County. Clark and Floyd counties are currently designated as an area that does not meet the one-hour standard. However, data from 1998 - 2000 show that air quality in these counties improved, so IDEM began the process of re-designating them to meeting the standard. In Lake and Porter counties, air quality recently has met the one-hour standard, but these counties are part of a larger metropolitan area that does not meet the standard.

In July 1997, U.S. EPA established a stricter ozone standard based on health studies addressing longer term exposure. The standard is 85 ppb measured over eight hours, which more closely reflects exposure of people who work and play outside in the summer. However, an air quality monitor is considered in violation of the standard when the average of its fourth highest reading in each of three years equals or exceeds 85 ppb. During 2000, the highest eight-hour ozone concentration in the state was 103 ppb, recorded at Michigan City in Laporte County. Six metropolitan areas in Indiana are at risk for not meeting the eight-hour standard.

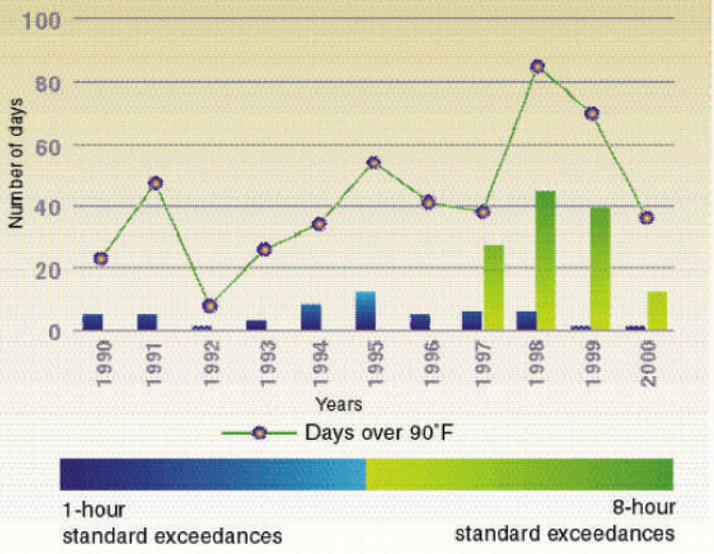
Areas Not Likely to Meet the Ozone Standard

Source: IDEM Office of Air Quality, 2000



Indiana Unhealthy Ozone Days*

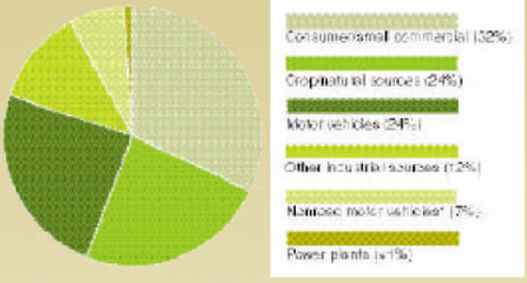
Source: IDEM Office of Air Quality, 2000



*IDEM began recording 8-hour ozone values in 1997 when U.S. EPA adopted the standard.

Major Contributors to Ozone Sources of Volatile Organic Compounds in Indiana

Source: IDEM Office of Air Quality, 1999



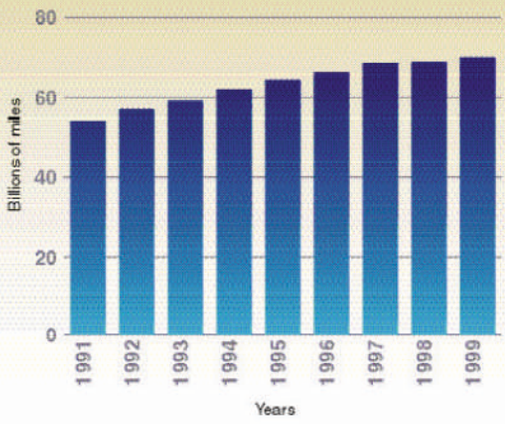
Sources of Nitrogen Oxides in Indiana

Source: IDEM Office of Air Quality, 1999

* Nonroad motor vehicles – agriculture, lawn, recreational and construction equipment

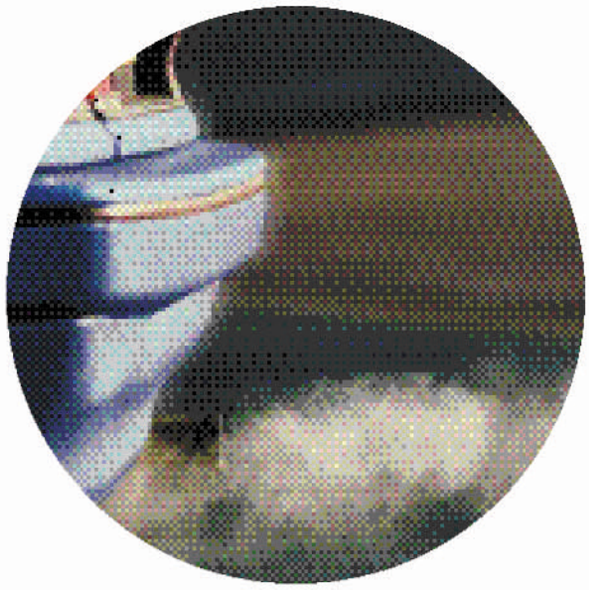
Annual Vehicle Miles Traveled in Indiana

Source: Federal Highway Administration, 2000



OZONE SOURCES

Motor vehicles, manufacturing, industrial and everyday activities emit nitrogen oxides and volatile organic compounds that react in sunlight to form ozone. Pollutants that cause ozone include gasoline vapors, chemical solvents and combustible fuels. Certain emissions can cause ozone at greater distances. Emissions of nitrogen oxides from tall sources, such as smoke stacks, are more likely than sources near ground level to travel downwind and increase ozone levels in surrounding urban and rural areas.



VEHICLE MILES TRAVELED

Cars and trucks are important sources of carbon monoxide, nitrogen oxides, particulate matter and volatile organic compound emissions. Vehicle miles traveled data is used to estimate emissions of these pollutants.

In 1999, Hoosiers drove over 70 billion miles, an average of almost 192 million miles per day. From 1991 to 1999, annual vehicle miles traveled increased by 29 percent; Indiana's population increased by about seven percent during the same period. The increasing rate of vehicle miles traveled reduces the air quality benefits from cleaner vehicles and fuels. By 2010, data projections indicate that Hoosiers will travel more than 100 billion vehicle miles annually. Other environmental and economic impacts result from increased traffic congestion and additional road construction and maintenance.

REGIONAL NATURE OF OZONE

Ozone is formed locally and transported by wind. Ozone and the pollutants that form it can be carried significant distances downwind from their points of origin.

Indiana's cars, factories and other human activities generate the pollutants that form ozone that is transported within Indiana and to other states. In turn, ozone generated by our neighboring states is carried across our borders and affects the quality of air Indiana's citizens breathe. Consequently, Indiana communities that do not meet ozone health standards cannot solve ozone problems alone. Many actions are occurring at local, state and federal levels to reduce the pollutants in the Midwest that cause ozone. Light winds and sunny, warm weather provide ideal conditions for ozone formation. The adjacent maps show eight-hour average ozone concentrations as they changed on June 9, 2000. Notice how ozone concentrations climb through the day as temperatures reach the mid 80s during the afternoon. Ozone levels fall as the temperature cools off in the evening. This is why it is better to drive your car, fill it up, and mow your grass after 6 p.m. on Ozone Action Days. The ozone levels are based on monitoring data put into a model that shows regional ozone patterns. The maps also demonstrate how ozone spreads and that it is not necessarily concentrated in urban areas.

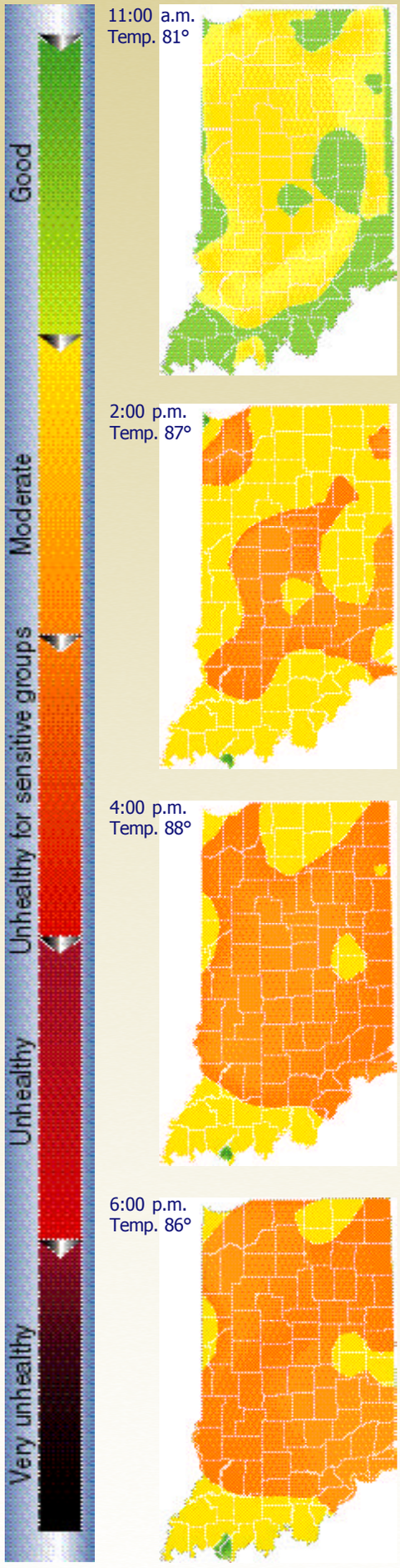
IDEM's ***Smog Watch*** Web page provides Indiana citizens with information and data concerning ozone levels across the state. ***Smog Watch*** will alert you to Ozone Action Days (summertime days with unhealthy levels of ozone) and allow you to view actual, hourly ozone data recorded at ozone monitoring sites around the state. You can also view the highest ozone value recorded the previous day. ***Smog Watch*** is your link to Indiana's ozone monitoring network and information concerning ozone pollution.

To access ***Smog Watch*** during Indiana's Ozone Season (April 1 through September 30), visit IDEM's Web site at

www.in.gov/idem/smog

Ozone 8-Hour Values on June 9, 2000

Source: U.S. Environmental Protection Agency, 2000



WORKING TOGETHER TO SEE BETTER:

IDEM PARTICIPATES IN REGIONAL EFFORTS TO REDUCE THE POLLUTANTS THAT CAUSE HAZY DAYS

Haze obscures the clarity, color, texture and form of what we see. Haze is caused when light encounters tiny pollution particles and some gases in the air. The particles and gases absorb some light and other light is scattered away before it reaches the ground. Some haze-causing pollutants are formed when gases emitted to the air form particles as they are carried many miles from the source of the pollutants. Particles that are formed from gases include sulfates, nitrates and some organic carbon particles. Other haze-causing pollutants (mostly small particles) are directly emitted to the atmosphere from sources such as electric utilities and industrial fuel burning, manufacturing processes and vehicle emissions. Natural sources such as forest fires and windblown dust also contribute to haze.

Because the pollutants that cause hazy days can be transported many miles from their source, the collective actions by the midwest region states and federal agencies are needed. In 1999, the U.S. EPA issued regional haze regulations that require all states to develop long-term strategies to improve visibility in 156 national park and wilderness areas throughout the United States. In 2000, Indiana and the other Midwestern states formed the Midwest Regional Planning Organization. The purpose of the group is to monitor the amount of haze in the Midwest and study the relationship of fine dust and soot, ozone and other pollutants in the formation of regional haze. Additional goals include determining the impact of haze on national parks and wilderness areas, and proposing strategies to address any impacts.

For more information on the Midwest Regional Planning Organization and to read the Regional Haze Newsletter, check out their Web site at:

www.ladco.org/rpo/rpo.html

SULFUR DIOXIDE

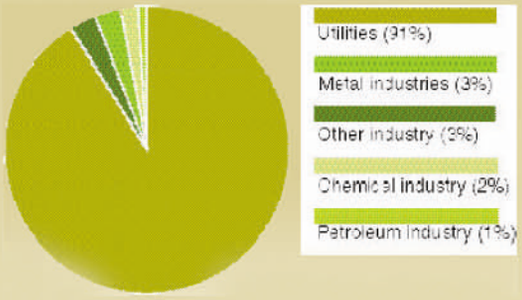
Populations particularly sensitive to sulfur dioxide include children, older adults, asthmatics and people with chronic lung and cardiovascular diseases. Sulfur dioxide is a primary component of acid rain, which is discussed on page 19. Sulfur dioxide emissions are generally on the decline with annual variations linked to electricity generation.

Sulfur dioxide levels in Indiana's air have decreased dramatically. All areas of Indiana currently meet state and federal health standards for sulfur dioxide as measured by air quality monitors. Many Indiana power plants have greatly reduced sulfur dioxide emissions by using lower sulfur coal, increasing use of lower polluting boilers, and investing in air pollution control equipment, such as scrubbers.

The bottom graph demonstrates how levels of sulfur dioxide have decreased since the mid-1980s statewide and in Evansville, an area heavily influenced by power plants. Annual averages remain well below the federal health standard.

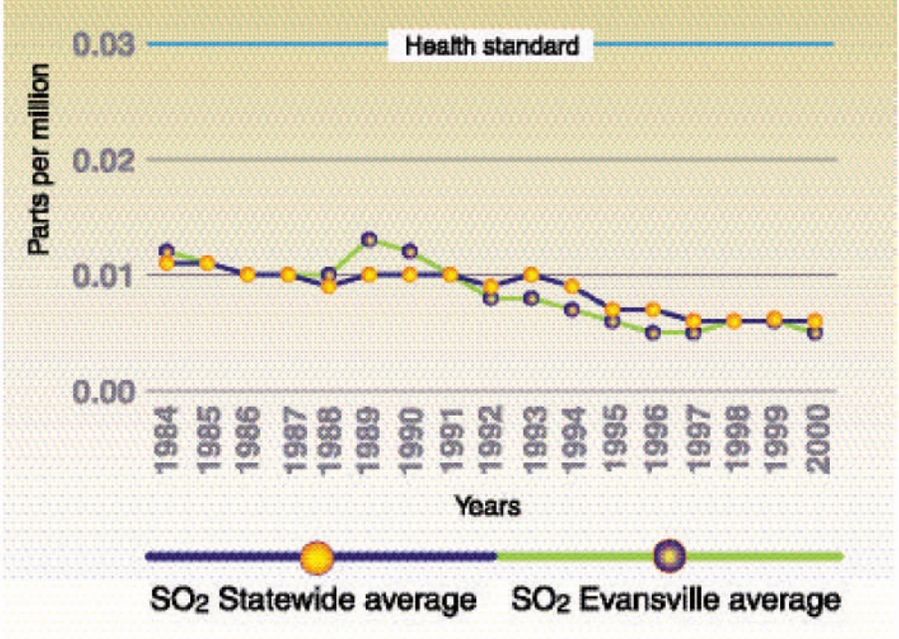
Indiana Sulfur Dioxide Emissions by Industry

Source: IDEM Office of Air Quality, 2000



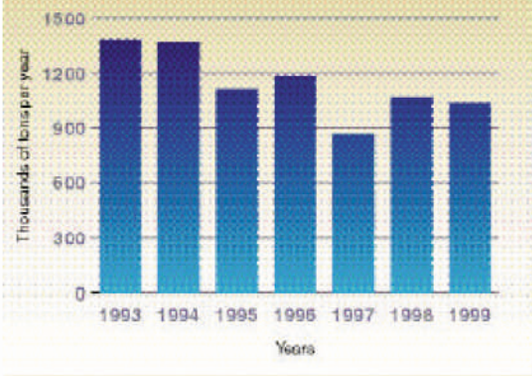
Sulfur Dioxide Air Quality Statewide and Evansville Average

Source: IDEM Office of Air Quality, 2000



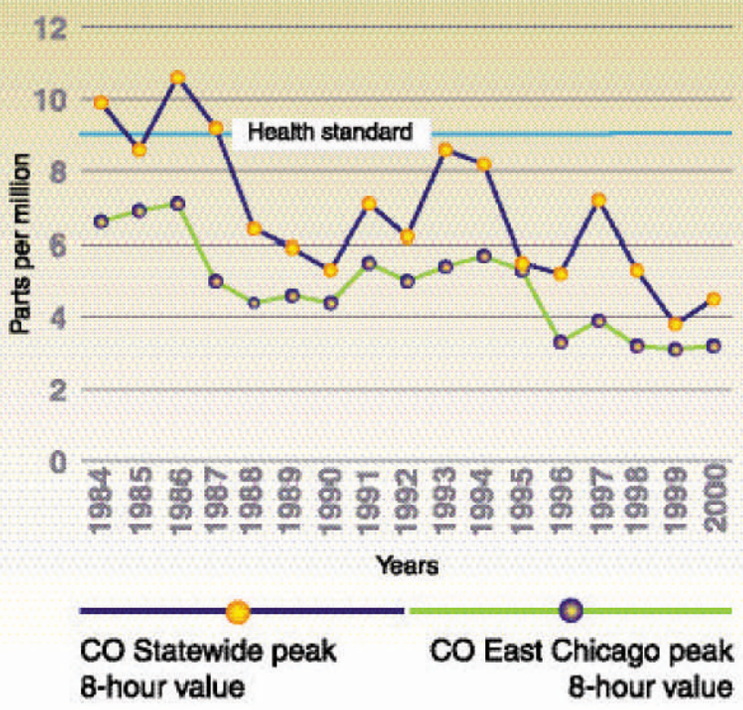
Indiana Industrial Sulfur Dioxide Total Emissions

Source: IDEM Office of Air Quality, 2000



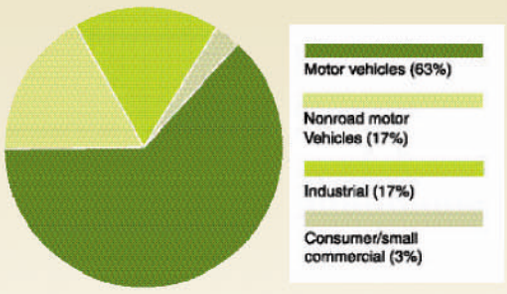
Carbon Monoxide (CO) Air Quality Statewide and East Chicago Peak 8-Hour Value

Source: IDEM Office of Air Quality, 2000



Indiana Carbon Monoxide Emissions

Source: IDEM Office of Air Quality, 1999



CARBON MONOXIDE

Carbon monoxide in the bloodstream reduces the flow of oxygen to tissues and organs, thereby reducing vision and coordination, and causing dizziness and reduced learning ability. Carbon monoxide is formed from incomplete combustion of fossil fuels and carbon containing materials. Sources of carbon monoxide include vehicles, industrial processes and fuel combustion in boilers and incinerators.

All areas of Indiana currently meet federal health standards for carbon monoxide. Industrial emissions have shown some increases in recent years, possibly due to variations in manufacturing and power generation. However, industrial emissions are only 17 percent of statewide carbon monoxide emissions. Overall, most carbon monoxide in the air comes from motor vehicles. Carbon monoxide levels continue to be below the federal health standards as measured by air monitors, primarily due to stricter emission standards for new cars and improved combustion techniques and emission controls.

Levels of carbon monoxide have generally declined since the mid 1980s. The graph on the left demonstrates an industrialized area, East Chicago, where levels of carbon monoxide are well below the health standard.

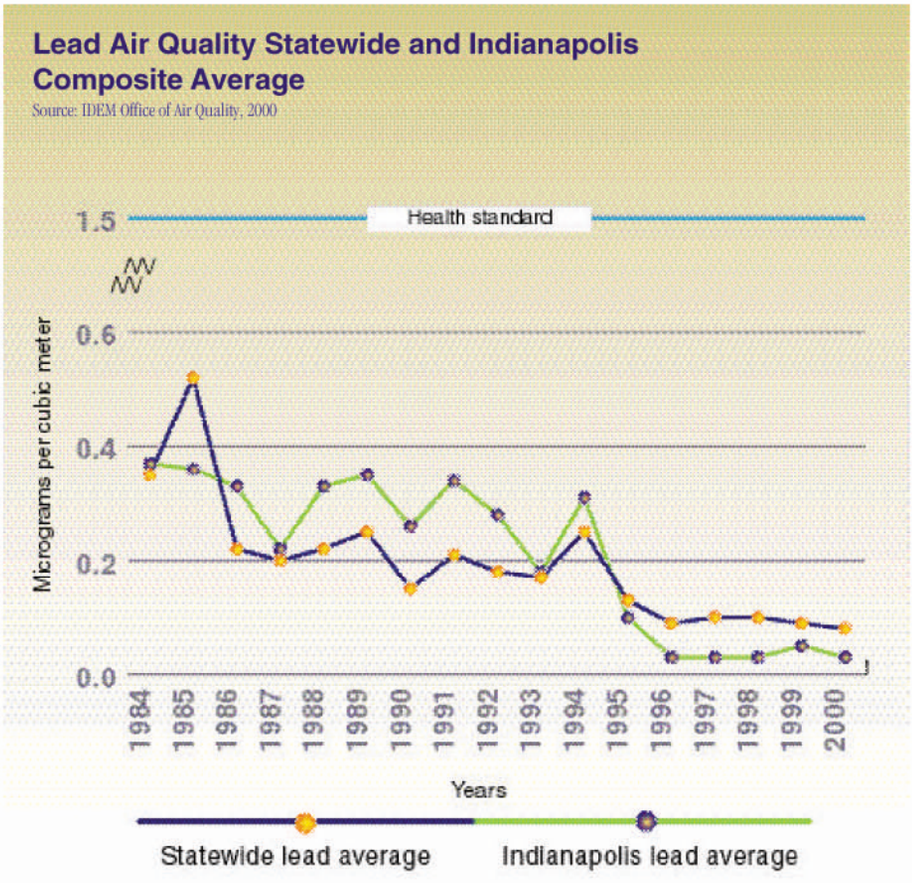
LEAD

Excessive exposure to lead can result in lead poisoning and elevated blood-lead levels, which may cause mental and physical damage to young children. In the past, the major source of lead was motor vehicles. The prohibition of leaded gasoline in 1975 significantly lowered lead levels in the air. The remaining sources of lead include lead paint in older homes, contaminated soils and facilities that process or produce materials that contain lead. Aggressive state rules that limit emissions from these facilities help assure that no areas of Indiana have unhealthy lead levels in the air.

The bottom graph demonstrates that in Indianapolis, regulations and the closing of a lead processing facility resulted in dramatic reductions in airborne lead.

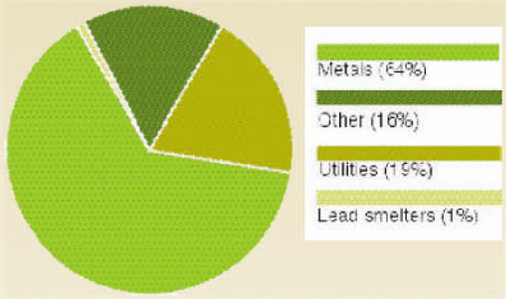
Lead Air Quality Statewide and Indianapolis Composite Average

Source: IDEM Office of Air Quality, 2000



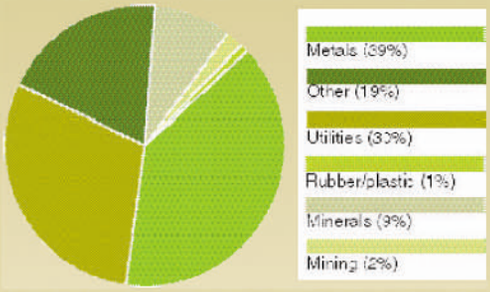
Indiana Lead Emissions by Industry

Source: IDEM Office of Air Quality, 2000



Indiana Dust and Soot Emissions by Industry

Source: IDEM Office of Air Quality, 2000



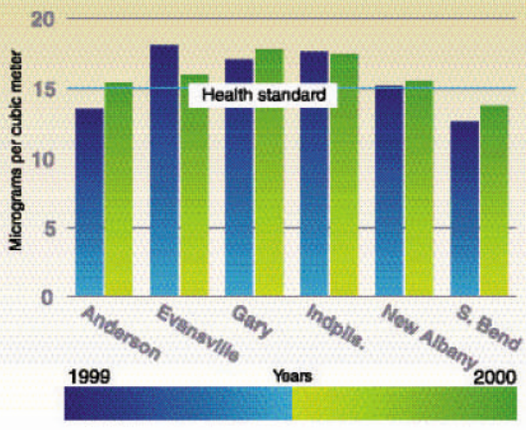
DUST AND SOOT

Particulates are small pieces of dust, dirt and soot and aerosol mists emitted by sources such as cars, trucks, construction projects, factories, unpaved roads, fireplaces and wood stoves. Older adults, children and people with chronic lung disease are especially sensitive to particulates.

Recent studies indicate that the smallest particulates pose the most serious health threat, because they can be inhaled more deeply into the lungs and are more difficult to exhale. In 1997, U.S. EPA established a new standard for particulates from 10 microns (called PM_{10}), to less than 2.5 microns (called $PM_{2.5}$). For comparison, a human hair is about 70 microns wide. In 1999 and 2000, Indiana established monitoring sites for $PM_{2.5}$. Currently, there are 40 operating monitors located throughout the state to evaluate the new standard. After three years of data have been collected from these monitors, IDEM and U.S. EPA will determine whether any areas in Indiana exceed the new health standard for small particulates. All monitors in Indiana now meet the air quality standard for PM_{10}.

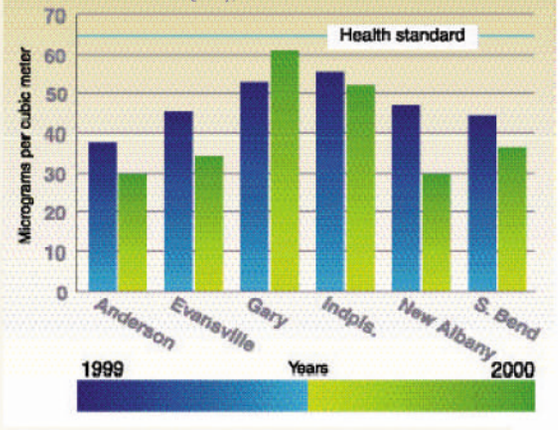
Highest Annual Average Fine Particulate Air Quality ($PM_{2.5}$)

Source: IDEM Office of Air Quality, 2000



Highest Daily Concentration Fine Particulate Air Quality ($PM_{2.5}$)

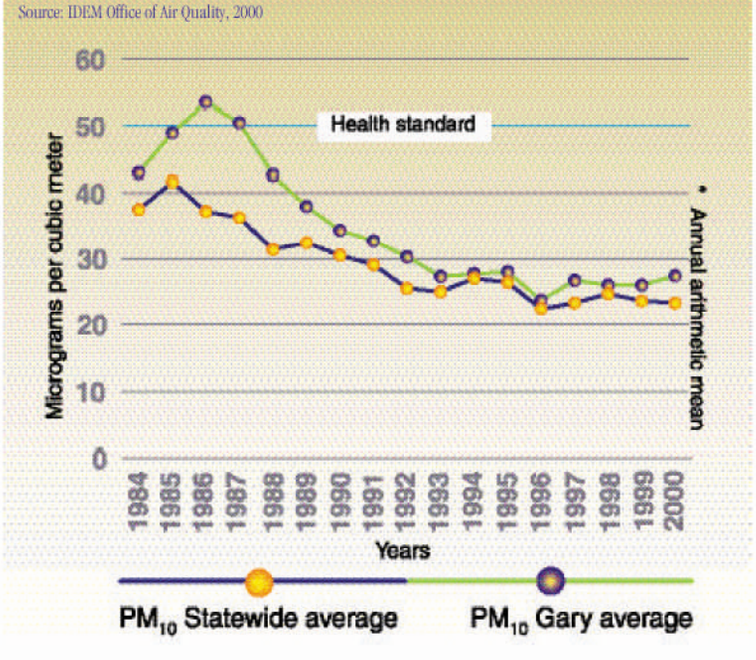
Source: IDEM Office of Air Quality, 2000



Data have been collected on larger particles, PM_{10}, for a number of years. Levels of PM_{10} in Indiana's air have fallen dramatically since the mid 1980s, especially in areas such as Gary, where health standards were previously exceeded.

Particulate Matter Air Quality (PM_{10}) Statewide and Gary Average

Source: IDEM Office of Air Quality, 2000



AIRBORNE TOXIC AND OTHER ORGANIC COMPOUNDS

Many chemicals in the air affect human health and the environment. Some chemicals occur naturally. Others are released by a variety of human activities, such as manufacturing, driving, cleaning or painting. Some of these chemicals can cause health problems at very low concentrations. For some chemicals, the effects are immediate; for others, they are longer term, including a possible increased risk of certain cancers.

Congress has designated 188 chemicals as hazardous air pollutants, often referred to as "air toxics," because they are known to cause serious health impacts. Other specific organic compounds contribute to the formation of ozone. However, U.S. EPA has not yet set health standards for these air toxics. Regulations to date have focused on specific industries to control air toxics with pollution prevention or pollution control technologies.

Monitoring for airborne toxics and other organic compounds began in Indiana in 1987 at a site in Hammond. In the past two years, both the number of monitoring sites and the number of chemicals being measured have increased. The line graph shows historical trends of methylene chloride at Hammond. Additional monitoring for 87 toxics and ozone causing chemicals began in 1999, with monitoring stations in Elkhart, Indianapolis, Evansville and Hammond. The bar charts display levels of methylene chloride and styrene in these cities.

For more information on air toxics, see page 20.

METHYLENE CHLORIDE

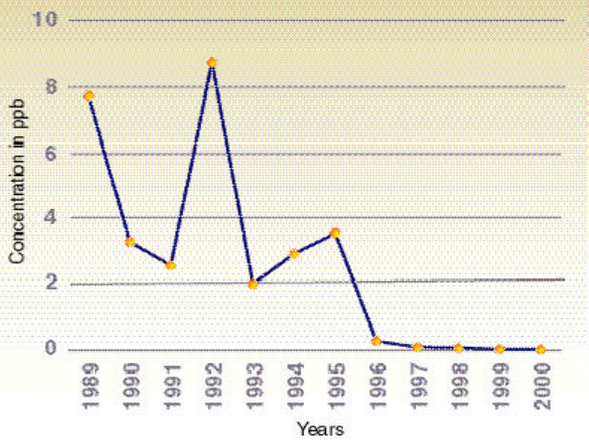
Methylene chloride is a colorless liquid with a sweetish odor. It is used as a solvent, a blowing agent and as a propellant in aerosols. In Indiana, the largest emitters of methylene chloride are flexible foam manufacturers, pharmaceutical and chemical industries and degreasing operations. The most common health effects from short-term exposure to methylene chloride are decreased visual and auditory functions. The U.S. EPA classified methylene chloride as a probable human carcinogen for long-term exposures.

STYRENE

Styrene is a colorless liquid that evaporates easily. The largest emitters of styrene in Indiana are manufacturers who use resins containing styrene to produce fiber-reinforced plastics found in boats, recreational vehicles, bathtubs and shower stalls. The most common health effects from short-term exposure to styrene may include depression, concentration problems, muscle weakness, unconsciousness, skin inflammation and nausea. The U.S. EPA classified styrene as a possible human carcinogen for long-term exposures.

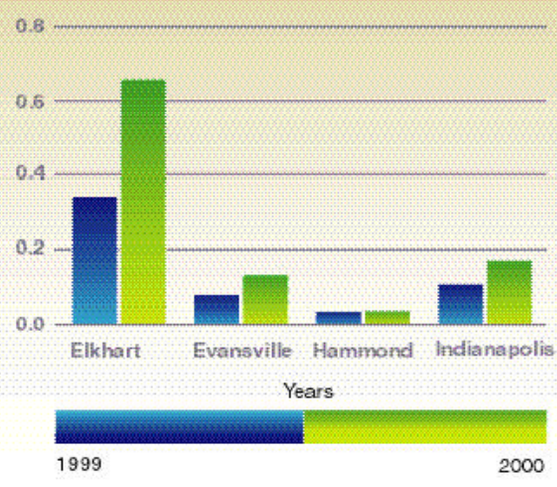
Hammond Methylene Chloride Annual Average

Source: IDEM, Office of Air Quality 2000



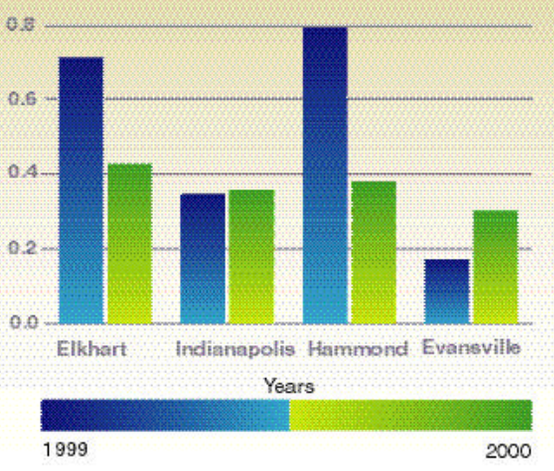
Methylene Chloride Annual Averages in Four Indiana Cities

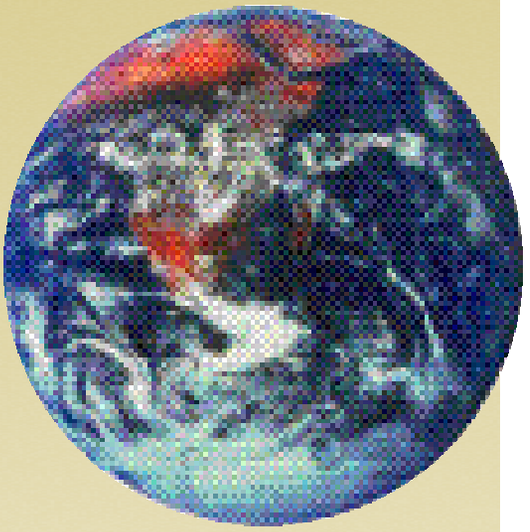
Source: IDEM, Office of Air Quality 2000



Styrene Annual Averages in Four Indiana Cities

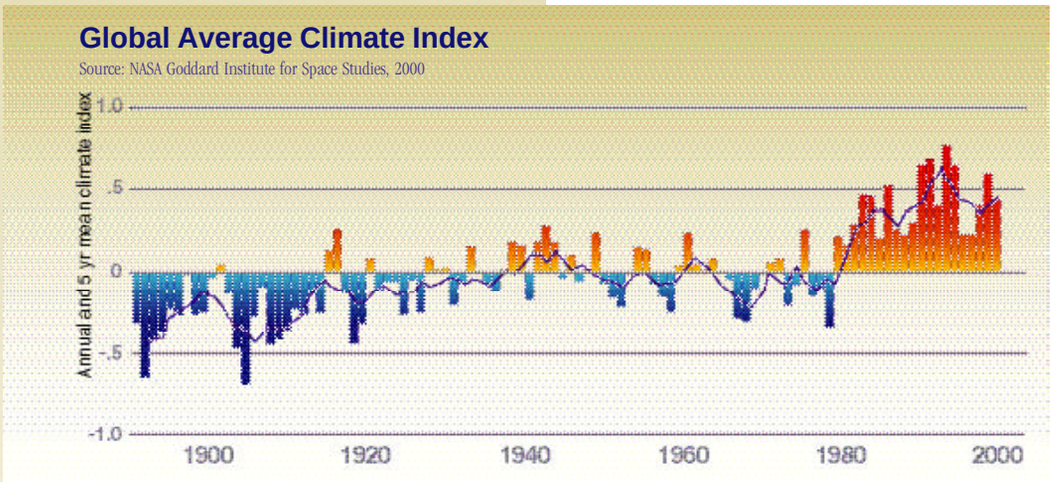
Source: IDEM, Office Air Quality 2000

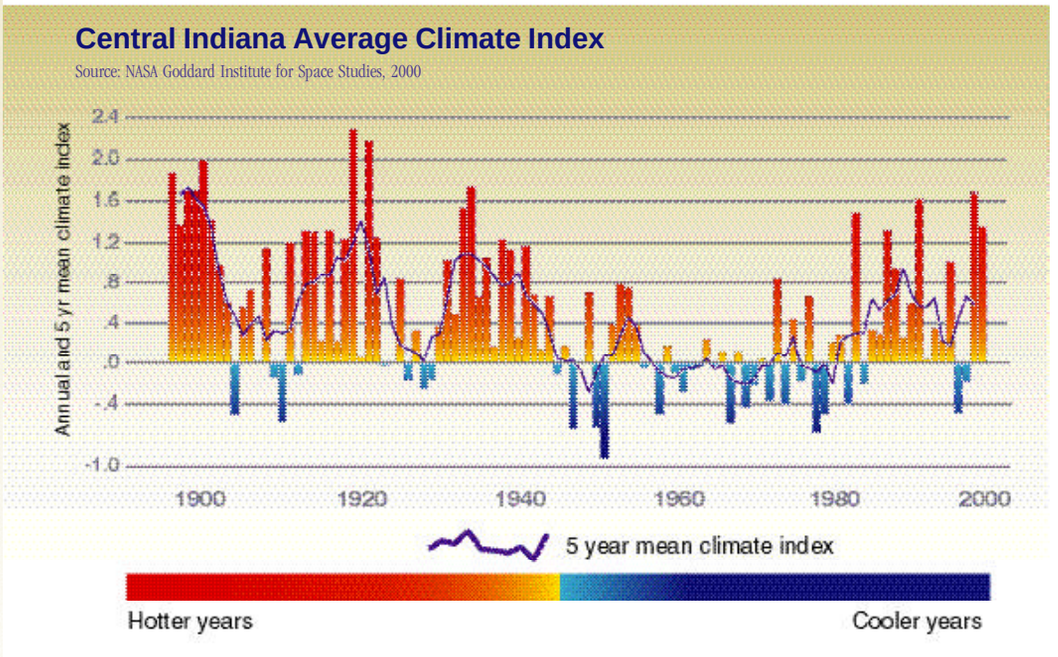




GLOBAL CLIMATE CHANGE

Recent data continue to confirm that global near-surface temperatures during the 20th century have been rising. A recent report by the Intergovernmental Panel on Climate Change projects that the Earth's average temperature could rise by as much as ten degrees Fahrenheit over the next 100 years. A long-term warming trend has been observed in the United States (0.5 degrees Celsius per century), with a substantial portion of the warming occurring since the mid-1970s. Greenhouse gases in the atmosphere, such as carbon dioxide, methane, nitrous oxide and chlorofluorocarbons, trap the heat of the earth and are thought by many scientists to be the cause of rising global temperatures. Global warming could change rain and temperature patterns and affect Indiana's agriculture and quality of life. According to the U.S. EPA, atmospheric concentrations of carbon dioxide increased nearly 30 percent, since the beginning of the industrial revolution. Methane levels are up over 100 percent, and nitrous oxide concentrations rose by 15 percent. Many everyday activities by individuals and businesses produce greenhouse gases. Fossil fuels that are burned to produce electricity, power factories, run cars and trucks, and heat homes and businesses are responsible for 98 percent of the United States' carbon dioxide emissions, 24 percent of the methane, and 18 percent of nitrous oxide emissions.





The graphs display the results of a climate index developed by NASA (the National Aeronautics and Space Administration). Using factors like average seasonal temperatures and the number of very hot or very cold days, years are rated as above (red) or below (blue) average. The global average and central Indiana climate indices are presented.

For more information on global climate change, see

www.epa.gov/globalwarming/ .

ACID RAIN

Acid rain describes rain or snow that has a pH lower than what is natural for a given area. Acid rain results from reactions involving sulfur dioxide and nitrogen oxides. When these gases react in the atmosphere with water, oxygen and other chemicals, acid rain is formed. Acid rain refers to both wet and dry deposition of acidic pollutants.

According to the U.S. EPA, about 2/3 of the nation's sulfur dioxide and 1/4 of all nitrogen oxides come from power plants that burn fossil fuels, such as coal. These pollutants also cause hazy days, the acidification of lakes and streams, and harm aquatic life. Acid rain damages forests and crops by affecting soil nutrients and killing essential bacteria. Acid rain causes less severe problems for much of Indiana's soils, because Indiana's soils are limestone-based and act as a natural buffer. Acid rain also accelerates the corrosion of cars and paints, metals and the deterioration of stone. These effects seriously reduce the value of buildings, bridges, statues, monuments and tombstones.

The harm to people from acid rain is not direct. Walking in acid rain is no more dangerous than walking in clean water. However, sulfur dioxide and nitrogen oxides create human respiratory health problems. These gases interact in the atmosphere to form fine sulfate and nitrate particles that can be transported long distances by winds and inhaled deep into people's lungs. Many scientists have identified a relationship between elevated levels of fine particles and increased illness and premature death from heart and lung disorders, such as asthma and bronchitis.

Collaborating with the U.S. EPA, IDEM supports the Acid Rain Program, which uses both traditional and innovative, market-based approaches for controlling air pollution. In 1999, nitrogen dioxide emissions from Indiana's large industrial sources were down over 26 percent from the high in 1996. Large industrial emissions of sulfur dioxide were also down in 1999 in Indiana.

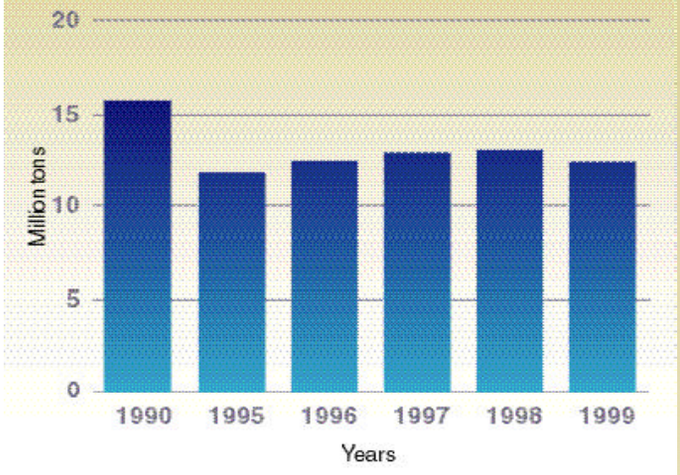
For more information on sulfur dioxide and nitrogen oxides, please see the ozone and sulfur dioxide sections of this report.

For more information on acid rain, go to U.S. EPA's Web site at

www.epa.gov/airmarkets/arp/ .

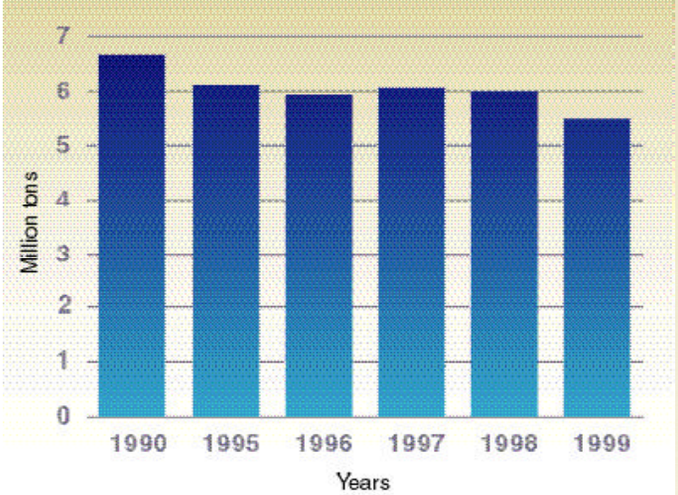
National SO_2 Emission Trends for Large Electrical Power Generators

Source: U.S. Environmental Protection Agency, Acid Rain Program Emission Scorecard, 2000



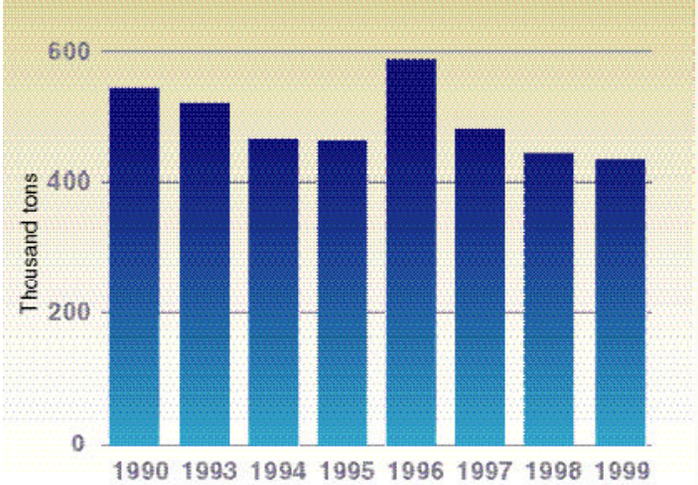
National NO_2 Emission Trends for Large Electrical Power Generators

Source: U.S. Environmental Protection Agency, Acid Rain Program Emission Scorecard, 2000



Indiana NO_2 Emissions From Large Industrial Sources

Source: IDEM,Office of Air Quality 2000



TOX WATCH IS LOOKING OUT FOR KIDS

ON JUNE 1, 1999, IDEM BEGAN A TWO-YEAR AIR MONITORING STUDY TO SUPPORT THE AGENCY'S REDUCING TOXICS INITIATIVE

The study is called, "TOX Watch." Air toxics monitoring stations were established in four urban areas with the highest reported releases of toxic chemicals to the air – Elkhart, Marion, Vanderburgh and Lake counties. A permanent monitoring station was located in each area for the duration of the study with three short-term (six-month) neighborhood assessment sites located on a rotating basis in each community. Air quality samples are collected in each community every six days over the two-year period of the study.

A focus of the study is to evaluate levels of air toxics where large populations and many children are located. Pound per pound, children inhale a larger volume of air per breath than adults. For this and other reasons, the effect of toxic emissions can be greater in children. IDEM selected many schools, parks and urban residential areas as locations for air monitors because these locations are where children live, play and learn. IDEM has been monitoring the air for 87 organic compounds during these two years.

At the end of the two years of monitoring, IDEM will issue a report on the findings. The report will be developed with the advice and input of the Air Toxics Advisory Group, which consists of technical representatives from academia, business and environmental groups. The advisory group will evaluate the report and participate in the longer-term policy discussions and development of next steps. Information on the levels of air toxics collected so far is on IDEM's Web site.

Air Toxics Monitor

www.in.gov/idem/air/toxwatch/index.htm

MERCURY: THE METAL FOUND IN AIR, WATER AND LAND

MERCURY IN INDIANA'S ENVIRONMENT IS A PUBLIC HEALTH CONCERN

Mercury can affect the central nervous system of adults and children, especially in its organic form (called methylmercury). Mercury in the atmosphere can be the result of human activities, such as emissions from power plants and municipal waste incinerators. Atmospheric mercury also can originate from natural processes such as forest fires and volcanoes.

According to the U.S. EPA and research scientists, rain and snow are the primary ways mercury moves from the air to the earth's surface. This process is called atmospheric deposition. Before 2000, data on the movement of mercury were not collected in Indiana. These data are needed to understand the cycling of mercury in Indiana's air, water and land. In 2000, IDEM entered into a cooperative agreement with the U.S. Geological Survey (USGS) to monitor the atmospheric deposition of mercury in Indiana's environment. Mercury will be monitored at four sites in Indiana from 2001 through at least 2003.

The monitoring sites will be part of a national network and the data will be directly comparable to other states and regions represented by the national network. Data and interpretations from the project will be published in fact sheets and a report by the USGS. Project information will be posted on the Internet.

The goals of the project are to:

- Determine if there is uniform distribution of mercury in precipitation within the state or if patterns increase locally by sources of mercury emissions, such as power plants, incinerators or industrial sources,
- Determine if there are seasonal or annual trends in concentrations and deposition rates of mercury in precipitation,
- Provide mercury concentrations and deposition rates for comparison with other states, and
- Establish a baseline of concentrations, deposition rates in Indiana before implementing possible controls on sources of mercury air emissions.

Mercury Monitoring Station Locations

Source: IDEM, Office of Air Quality and the U.S. Geological Survey, 2000

Why were these four sites chosen?

- The Dunes National Lakeshore site provides data near numerous industrial sources of potential air emissions of mercury. It is also a reference site for the calculation of Total Maximum Daily Load for mercury in the Grand Calumet River.
- The Huntington Reservoir site provides background data in a rural location, distant from large sources of potential air emissions of mercury.
- The Bloomington Airport site provides information about the amount of mercury transported from numerous power plants in southwestern and western Indiana.
- The Clifty Falls State Park site was chosen because it is located near the largest potential source of air emissions from electric power generation in Indiana. It also provides data on the transport of mercury into Indiana from power plants in Kentucky and Tennessee.